REMARKS

Favorable reconsideration of this application, as presently amended and in light of the following discussion, is respectfully requested.

Claims 1-51 are currently pending. Claims 1-3, 6, 18-20, 23, 35-37, and 40 have been amended by the present amendment. The changes to the claims are supported by the originally filed specification and do not add new matter.

In the outstanding Office Action, Claims 1-7, 12, 14, 15, 18-24, 29, 31, 32, 35-41, 46, 48, and 49 were rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 5,881,124 to Giger et al. (hereinafter "the '124 patent") and U.S. Patent No. 6,272,366 to Vining (hereinafter "the '366 patent"); and Claims 8-11, 13, 16, 17, 25-28, 30, 33, 34, 42-45, 47, 50, and 51 were rejected under 35 U.S.C. § 103(a) as being unpatentable over PCT Application Publication No. WO 99/42031 to Armato et al. (hereinafter "the '031 application") in view of the '124 patent.

Amended Claim 1 is directed to a method for the automated segmentation of lung regions in thoracic images, comprising (1) acquiring image data representative of a cross-sectional thoracic image; (2) establishing a seed point within the cross-sectional thoracic image based on the image data, the seed point corresponding to a major airway; (3) growing the seed point to segment the major airway; (4) segmenting the lung regions; (5) excluding the major airway from the lung regions within the cross-sectional thoracic image; and (6) performing region growing from another seed point located in a subsequent cross-sectional thoracic image. Claim 1 has been amended to include the step of *performing region growing from another seed point located in a subsequent cross-sectional image* to segment the major

airway within the subsequent cross-sectional thoracic image. The changes to Claim 1 are supported by the originally filed specification and do not add new matter.[1]

Regarding the rejection of Claim 1 under 35 U.S.C. § 103, the Office Action asserts that the '124 patent discloses everything in Claim 1 with the exception of the establishing, growing, and segmenting steps, and relies on the '366 patent to remedy those deficiencies.

Applicants respectfully submit that the rejection of Claim 1 (and dependent Claims 2-5) under 35 U.S.C. § 103 is rendered moot by the present amendment to Claim 1.

The '124 patent is directed to a method and system for the automated detection of lesions in computed tomographic images, including the detection of the thorax and lung boundaries. However, as admitted in the Office Action, the '124 patent fails to disclose the steps of (1) establishing a seed point within a cross-sectional thoracic image based on image data; (2) growing the seed point to segment the major airway; and (3) segmenting the lung regions. Moreover, Applicants respectfully submit that the '124 patent fails to disclose *performing region growing from another seed point located in a subsequent cross-sectional thoracic image* to segment the major airway within the subsequent cross-sectional thoracic image, as recited in amended Claim 1.

The '366 patent is directed to a method and system for providing interactive three-dimensional renderings of selected body organs having hollow lumens to enable simulated movement through the lumen. The '366 patent discloses a region-growing technique to isolate the air column within the colon in which a seed is planted by selecting a data point or voxel within the air column of the colon. The seed region continues to expand or grow until the entire air column within the lumen of the colon is filled.[2] However, Applicants respectfully submit that the '366 patent fails to disclose performing region growing from a second seed point located in a subsequent cross-sectional thoracic image to segment the

[1] See page 9 of the specification.
[2] '366 patent, column 3, lines 21-30.

major airway within the subsequent cross-sectional thoracic image, as recited in amended Claim 1. Rather, the '366 patent discloses a method in which region growing is performed on three-dimensional volume data, rather than in sequential cross-sectional thoracic images.

Thus, no matter how the teachings of the '124 and '366 patents are combined, the combination does not teach or suggest the step of performing region growing from another seed point located in a subsequent cross-sectional image to segment the major airway within the subsequent cross-sectional thoracic image, as recited in amended Claim 1. Accordingly, Applicants respectfully submit that Claim 1 (and dependent Claims 2-5) patentably define over any proper combination of the '124 and '366 patents.

Independent Claims 18 and 35 recite limitations analogous to the limitations recited in Claim 1. Moreover, Claims 18 and 35 have been amended in a manner analogous to the amendment to Claim 1. Accordingly, for the reasons cited above for the patentability of Claim 1, Applicants respectfully submit that the rejections of Claim 18 (and dependent Claims 19-22) and Claim 35 (and dependent Claims 36-38) are rendered moot by the present amendment to Claims 18 and 35.

In addition, regarding Claim 2, Applicants note that the '366 patent fails to disclose determining a first pixel corresponding to a center of mass of segmented major airway, as recited in Claim 2. Moreover Applicants note that the Office Action asserts that "it is obvious to one skilled in the art for a dilation process in image processing ... [that] the seed point is placed in the center of the region of interest."[3] However, the Office Action has failed to indicate why one of ordinary skill in the art would determine the center of mass of a segmented major airway.

Further, regarding Claim 3, Applicants note that the Office Action asserts that it would have also been obvious to one skilled in the art that "placing the seed point is a matter

[3] Page 3 of the Office Action dated March 29, 2004.

of configuration in the process of image dilation (it can be placed on the pixel with lowest/highest intensity/density, on an edge, boundary, or contour of an object, and the center/core of the object, etc.)."[4] However, the Office Action has failed to point to any references of record that disclose selecting a seed point at a lowest density pixel within a search region, wherein the search region is centered over a second pixel corresponding to a first pixel in a subsequent cross-sectional thoracic image, as recited in Claim 3. Moreover, the Office Action has failed to indicate *why* those steps would be obvious.

Claim 6 is directed to a method for the automated segmentation of lung regions in thoracic images, comprising: (1) generating at least one lung contour to segment the lung regions in a cross-sectional thoracic image; (2) identifying fusion of the lung regions; (3) identifying a cleft point on the at least one lung contour; (4) determining the average gray level value of pixels along line segments extending from the cleft point to an upper edge of the lung regions; (5) identifying the interior junction line based on the line segment with the highest average gray level value; and (6) extracting from the lung regions to the pixels along the interior junction line to separate the lung regions. Claim 6 has been amended for the purpose of clarification only and no new matter has been added.

Regarding the rejection of Claim 6 under 35 U.S.C. § 103, the Office Action asserts that the '124 patent discloses everything in Claim 6 with the exception of "to analyze the images for specific anatomical locations in the images such as the fusion of the lungs, the cleft point, the anterior junction line, etc.," but states that those steps would have been obvious to one of ordinary skill in the art.[5]

As discussed above, the '124 patent is directed to a method and system for the automated detection of lesions in computed tomographic images. However, as admitted in the Office Action, the '124 patent fails to disclose the steps of (1) identifying the fusion of the

[4] See page 4 of the Office Action dated March 29, 2004.
[5] See page 5 of the Office Action dated March 29, 2004.

lung legions: (2) identifying a cleft point on the at least one lung contour; (3) determining the average gray level value of pixels along line segments extending from the cleft point to an upper edge of the lung region; (4) identifying the anterior junction line based on the line segment with the highest average gray level value; and (5) extracting from the lung regions the pixels along the anterior junction line to separate the lung regions.

Regarding the motivation to modify the combined teachings of the '124 and '366 patent, the Office Action merely asserts that it would have been obvious to one skilled in the art to modify the teachings of those patents to detect "any number of anatomical points of the lungs" in order "to enhance the region of interest in the images."[6] However, Applicants respectfully submit that the Office Action is simply engaging in hindsight reconstruction of Applicants' invention, without identifying that, absent Applicants' specification, one of ordinary skill in the art would have even thought to identify, e.g., fusion of the lung regions, a cleft point on at least one lung contour, and the interior junction line, as recited in Claim 6. Moreover, Applicants submit that by stating that the identification of specific anatomy within a cross-sectional thoracic image is obvious, the Office Action is effectively asserting that methods for the computer-aided detection of objects in images are unpatentable.

Accordingly, for the reasons stated above, Applicants respectfully submit that a *prima facie* case of obviousness has not been established that the rejection of Claim 6 (and dependent Claim 7) should be withdrawn.

Independent Claims 23 and 40 recite limitations analogous to the limitations recited in Claim 6. Accordingly, for the reason stated above for the patentability of Claim 6, Applicants respectfully submit that a *prima facie* case of obviousness has not been established and the rejection of Claim 23 (and dependent Claim 24) and Claim 40 (and dependent Claim 41) should be withdrawn.

[6] See page 5 of the Office Action dated March 29, 2004.

Claim 12 is directed to a method for the automated segmentation of lung regions in thoracic images, comprising: (1) acquiring image data representative of a cross-sectional thoracic image; (2) generating initial lung contours to segment the lung regions in the cross-sectional thoracic image; (3) identifying within the lung region at least one portion corresponding to the diaphragm; and (4) excluding from the lung regions at least one portion corresponding to the diaphragm.

Regarding the rejection of Claim 12 under 35 U.S.C. § 103, the Office Action merely asserts that Claim 12 is rejected for the same reasons as Claims 1 and 6 combined. However, Applicants respectfully submit that the '124 and '366 patents, taken either singly or in proper combination, fail to disclose identifying within a lung region at least one portion corresponding to the diaphragm. Moreover, as discussed above, Applicants respectfully submit that the Office Action fails to provide any motivation to one of ordinary skill in the art to modify the combined teachings of the '124 and '366 patents to include a mechanism for identifying the diaphragm within a segmented lung region. Accordingly, for the reasons stated above, Applicants respectfully submit that a *prima facie* case of obviousness has not been established and the rejection of Claim 12 (and dependent Claims 14 and 15) should be withdrawn.

Independent Claims 29 and 46 recite limitations analogous to the limitations recited in Claim 12. Accordingly, for the reasons stated above for the patentability of Claim 12, Applicants submit that a *prima facie* case of obviousness has not been established and that the rejection of Claims 29, 31, 32, 46, 48, and 49 should be withdrawn.

Claim 8 is directed to a method for the automated segmentation of lung regions in thoracic images, comprising: (1) acquiring image data representative of a cross-sectional thoracic image; (2) generating initial lung contours to segment the lung regions and the cross-sectional thoracic image; (3) refining the lung contours by applying a rolling ball filter to the

initial lung contours to identify indentations along the initial lung contours; (4) determining, for each indentation identified by the rolling ball filter, whether the indentation corresponds to the diaphragm; and (5) preventing the rolling ball filter from including within the segmented lung regions the indentations corresponding to the diaphragm.

Regarding the rejection of Claim 8 under 35 U.S.C. § 103, the Office Action asserts that the '031 application discloses everything in Claim 8 with the exception of acquiring image data representative of a cross-sectional thoracic image, and determining whether indentations correspond to the diaphragm, and relies on the '124 patent to disclose the cross-sectional thoracic image. In addition, the Office Action asserts that the identification of indentations and the determination of whether the indentations correspond to the diaphragm would have been obvious to one of ordinary skill in the art "in order to know where the indentations are present, the respective sizes in which contours in the image contain these indentations such as the diaphragm so that the algorithm is only applied to these locations contours...."[7]

Applicants respectfully submit that the Office Action has failed to identify motivation for one of ordinary skill in the art to modify the teachings of the '031 application and the '366 patent to include the steps of (1) refining the lung contours by applying a rolling ball filter to the initial lung contours to identify indentations along the initial lung contours, and (2) determining for each indentation, whether the indentation corresponds to the diaphragm. Rather, the Office Action merely asserts that one of ordinary skill in the art would want to perform those steps because those steps would provide useful information. However, the Office Action has failed to identify any reference of record that discloses those steps or any reasons why those steps would be obvious. Accordingly, for the reasons stated above, Applicants respectfully submit that a *prima facie* case of obviousness has not been

[7] See page 7 of the Office Action dated March 29, 2004.

established and that the rejection of Claim 8 (and dependent Claims 9 and 10) should be withdrawn.

Claims 25 and 42 recite limitations analogous to the limitations cited in Claim 8. Accordingly, for the reasons stated above and for the patentability of Claim 8, Applicants respectfully submit that a *prima facie* case of obviousness has not been established and that the rejection of Claim 25 (and dependent Claims 26 and 27) and Claim 42 (and dependent Claims 43 and 44) should be withdrawn.

Claim 11 is directed to a method for the automated segmentation of lung regions and thoracic images, comprising: (1) acquiring image data representative of plural cross-sectional thoracic images; (2) generating initial lung contours to segment the lung regions in the plural cross-sectional thoracic images; and (3) refining the lung contours by applying a three-dimensional rolling ball filter to the initial lung contours and the plural cross-sectional images.

Applicants respectfully submit that the '031 application and the '366 patents, taken either singly or in proper combination, fail to disclose a three-dimensional rolling ball filter. Accordingly, Applicants respectfully submit that a *prima facie* case of obviousness has not been established and that the rejection of Claim 11 should be withdrawn.

Claims 28 and 45 recite limitations analogous to the limitations recited in Claim 11. Accordingly, for the reasons stated above for the patentability of Claim 11, Applicants respectfully submit that a *prima facie* case of obviousness has not been established and that the rejection of Claims 28 and 45 should be withdrawn.

Regarding the rejection of dependent Claims 13, 16 and 17, under 35 U.S.C. § 103, Applicants respectfully submit that the '031 application fails to remedy the deficiencies of the '124 and '366 patents, as discussed above. Accordingly, Applicants respectfully submit that

a *prima facie* case of obviousness has not been established and that the rejection of dependent Claims 13, 16, and 17 should be withdrawn.

Dependent Claims 30, 33, 34, 47, 50, and 51 recite limitations analogous to the limitations recited in dependent Claims 13, 16, and 17, respectively. Accordingly, for the reasons stated above for the patentability of Claims 13, 16, and 17, Applicants respectfully submit that a *prima facie* case of obviousness has not been established and that the rejection of dependent Claims 30, 33, 34, 47, 50, and 51 should be withdrawn.

Thus, it is respectfully submitted that independent Claims 1, 6, 8, 11, 12, 18, 23, 25, 28, 29, 35, 40, 42, 45, and 46 (and all associated dependent claims) patentably define over any proper combination of the '124 patent, the '366 patent, and the '031 application.

Consequently, in view of the present amendment and in light of the above discussion, the outstanding grounds for rejection are believed to have been overcome. The application as amended herewith is believed to be in condition for formal allowance. An early and favorable action to that effect is respectfully requested.

Respectfully submitted,

OBLON, SPIVAK, McCLELLAND,
MAIER & NEUSTADT, P.C.

Kurt M. Berger

Eckhard H. Kuesters
Attorney of Record
Registration No. 28,870
Kurt M. Berger, Ph.D.
Registration No. 51,461

Customer Number
22850

Tel: (703) 413-3000
Fax: (703) 413 -2220
(OSMMN 08/03)
KMB:smi:law

I:\ATTY\KMB\200'S\200655US\200655US-AM.DOC